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Space systems — Project reviews

Systèmes spatiaux — Revues des programmes

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

ISO 21349 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

Introduction

Space systems are very complex, incorporating many different technologies. Space programs can last for many years, progressing through several different stages from conception to disposal or other disposition. When a space program advances from one stage to another substantial changes in the type and amount of resources required can occur. In addition, there may be attendant risks to either the success of the project or to the well being of project equipment or to personnel. Well-regulated project reviews can be an important factor in ensuring that all factors are ready for these changes, and that the risks are well understood and accepted.   Use of this standard as a basis for the activities comprising a review, their necessary resources, controls, inputs, and results is intended to enhance communications between different organizations that participate in a review process, and to reduce costs of planning and performing reviews.

Space systems — Project reviews

1   Scope

This international standard provides process requirements for project reviews as a set of required functions. The requirements and recommendations cover the function inputs, outputs, mechanisms, and controlling conditions. It is intended for use in implementing the review requirements of ISO 14300‑1, 14300‑2, 15865, and such other space systems and operations standards that require formal reviews.

This international standard specifies the responsibilities of a review board and gives guidance concerning review board composition.

This International Standard is applicable to reviews for a project at any level within a larger project, as well as for major milestone reviews at the top level of a major project. It is intended to be used either by an independent developer as a basis for enterprise processes, or as a basis for an agreement between a supplier and a customer.

This International Standard also provides normative descriptions of the kinds of reviews that are commonly useful in assuring the success of a space project.

2   Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 14300‑1:2001, *Space systems – Programme management – Part 1: Structuring a programme*

3   Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
independent expert
a person highly qualified in some aspect of the technical content of the project review who does not have a personal conflict of interest concerning the outcome of the review

3.2
milestone
designated project status that indicates the amount of progress made toward project completion, or that should be achieved before the project transitions to a new phase

3.3
milestone criteria
observable facts that indicate a milestone has been reached

3.4
project data files
collection of requirements, specifications, plans, technical result documentation, and all other project data that serves to represent the project status

3.5
project decision authority
entity with authority to certify that the preconditions for a review are met, to initiate the review process, to reach decisions on the review board recommendations, and to cause the agreed project actions to be carried out

3.6
project expert
person well acquainted with the project status and documentation, and highly qualified in some area of the technical content of the project review

3.7
project review team
body consisting of project experts, charged with preparing all evidence for the review and formulating responses to action items

NOTE—The best practice for conducting a review involves two separate teams of experts: the project review team and the review board. The "project review team" is composed of persons well acquainted with the project, and is responsible for assembling information concerning the actual status of the project. The "review board" is addressed in 3.8.

3.8
review board
body consisting of a review board chairperson or delegated person and review board members, charged with evaluating the evidence of project status

NOTE   The purpose of the review board is to prepare an objective evaluation of the project status. Achievement of an objective evaluation is aided by use of independent experts who have no prior association with the project, and no personal conflict of interest with respect to the outcome of the review.

3.9
review board chairperson
leader of the review board

3.10
review board member
an independent expert, sometimes termed a subject matter expert, who is a participant in the review board

3.11
review policy
policy that provides either requirements or guidance (or both) for the overall conduct of the review

olicy that provides either requirements or guidance (or both) for the overall conduct of the review

4   General

4.1 Purpose of a review

The purpose of a project review is to establish whether or not the project has reached a defined project milestone, and to identify specific actions necessary for the project to transition into the next phase.

NOTE   The flow of activities to achieve this purpose is one of identifying the participants and the plan, preparing the evidence of the project status, evaluating the evidence relative to milestone criteria, followed by preparation of specific recommendations based on the evaluation and performing actions identified by the review.

Typical milestones and their relation to space project phases are defined in ISO 14300-1, and in clause 6 of this International Standard.

4.2 Process model

4.2.1   Function hierarchy

The project review process is presented in the framework of a model using the syntax and semantics in IEEE 1320.1-1998. This model identifies the necessary functions to be performed in terms of the function name and purpose, its inputs, outputs, mechanisms, and controls. For reference, the essential features of the modelling syntax and semantics used in this International Standard are summarised in the informative Annex A. This International Standard uses the diagrammatic portion of IEEE 1320.1-1998 as a framework, and does not claim full compliance with IEEE 1320.1-1998.

For clarity in communicating the relationships between the review functions, the model is construed as a three level hierarchy of functions, as shown in Figure 1. This hierarchy can be used for guidance in planning reviews, but for a conforming application of this International Standard, it is not required to use this hierarchy to represent the process.

In a conforming application, the twelve functions at the third level of the hierarchy of Figure 1 shall be implemented. Detailed requirements and guidance for these functions are contained in Clause 5.

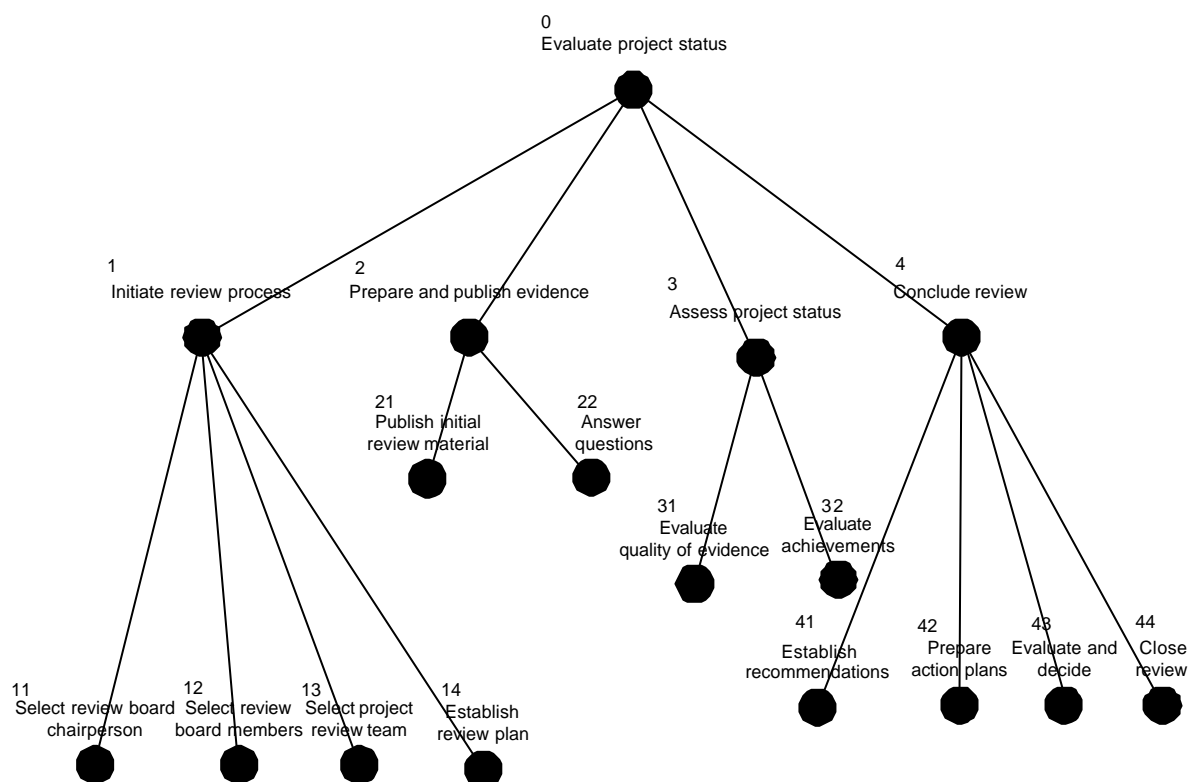**Figure 1 — Function Hierarchy**

4.2.2   Co-ordination of functions

A function may be performed concurrently with any other function, and in any order that is appropriate, so long as the necessary inputs, controls, and mechanisms are in place for the performance of the function. The performance of a function may be interrupted, if this is appropriate due to resource conflicts, for example.

In many cases the inputs, outputs, and controls can consist of many increments of data or other material that are available at distributed times. Similarly, not all personnel participating in implementing a function are needed for the production of some specific increment of output. In these cases, outputs may be produced incrementally, rather than held until the total output has been completed.

4.3 Review context

The review context, corresponding to level "0" of Figure 1, is shown in Figure 2. The central box represents the function performed by the complete review process. The function of the review process, as stated in 4.1, is to evaluate project status relative to a specified project milestone. For purposes of the diagram, this is abbreviated to "Evaluate project status." The incoming arrows at the top, left side, and bottom of the function box represent necessary preconditions for the review to be performed. Specifically:

— the review process is controlled by the project review policy and the milestone criteria;

— the input to the review process is the total set of project data files; and

— the mechanism for performing the review process includes:

— available independent experts,

— available project experts, and

— the project decision authority.

Requirements for these preconditions are given in 4.4.

The concrete result of the review is an agreed report of conclusions, recommendations and action items, and an approved plan for resolving any remaining problems. These outputs are shown at the right of the function box in Figure 2. Requirements for these outputs are given in 5.5.

Every model is an abstraction and includes only factors that are important from a certain viewpoint. The review process model used in this International Standard uses the viewpoint of project management.
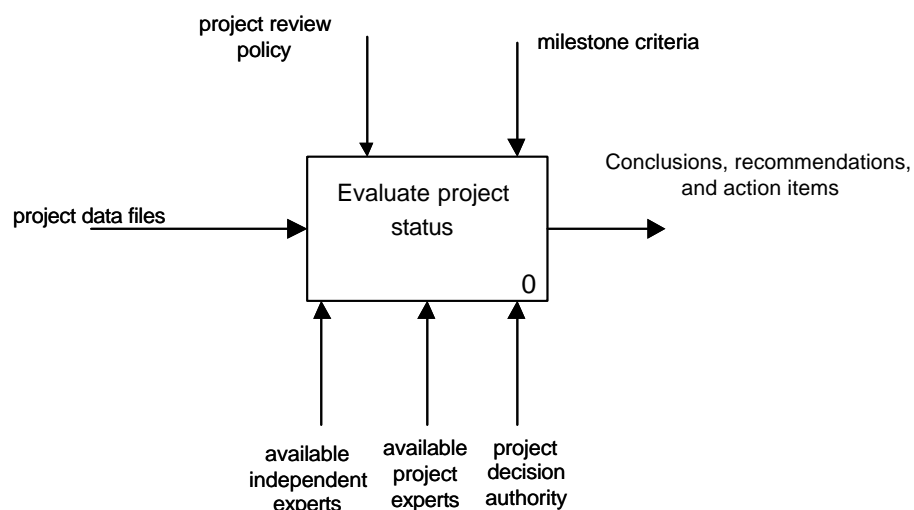

Figure 2 — Context diagram for the top level function: "Evaluate project status"

4.4 Preconditions for a review

4.4.1   General preconditions

4.4.1.1   Project review policy

The project shall have a review policy. Factors that should be considered for inclusion in the review policy include the following:

a)   selection of review board Chairperson and review board members,

b)   qualifications of review board members,

c)   number of review board members and distribution of technical expertise,

d)   style, format, and medium of review publications, presentations, and responses,

e)   rules of order for conduct of meetings,

f)   rules and procedures for the review board to reach recommendations,

g)   rules and procedures for reaching decisions which involve both the project decision authority and the review board,

h)   selection of members of the project review team, and

i)   establishment of a review plan.

4.4.1.2   Project decision authority

The project decision authority for the review shall be identified.

The project decision authority may be a single individual or a group of individuals that can reach a decision by vote, consensus, or some other established method.

In a project carried out under a contract between two or more parties, the contract should define the project decision authority for each review or type of review.

NOTE   The project decision authority can, depending on terms of a contract, include representatives of the customer, the supplier, or both the customer and the supplier. In case of internal reviews it can consist solely of representatives of the supplier.

4.4.1.3   Milestone criteria

The project shall have measurable criteria for assessing whether or not a milestone has been reached. These criteria shall include

—   identification of technical achievements, and

—   specification of how each technical achievement is to be evaluated for completeness and correctness.

4.4.2   Specific preconditions

4.4.2.1   Milestone criteria

A project can have internal progress reviews that result in changes in the overall project plan, and changes in the specific milestone criteria. Such changes can also result from prior milestone review action items. Re-

planning can also result from a variety of other factors. The project decision authority should confirm that milestone criteria to be used for the review are valid taking into account any re-planning that has occurred.

4.4.2.2 Technical preconditions

Conduct of the review depends on technical evidence. Examples of such evidence include test results, simulation results-off, trade studies, equipment inspections, and analyses. The project decision authority should ensure that evidence appropriate to the milestone exists in the project data files, and should receive assurance that project personnel believe this evidence will support an assessment that the milestone has been achieved.

4.4.2.3 Certification of precondition conformance and deviations

The project decision authority should certify that the preconditions of 4.4 have been met before initiating the review process.

If there are known deviations from these preconditions, the project decision authority may still decide to initiate the review. This should only be done if such a decision is consistent with the overall project plan and with any contractual agreements that exist.

If the decision to proceed is made in the presence of deviations, these deviations should be incorporated in a published modification to the review policy or the milestone criteria, as appropriate.

5 Review process

5.1 Overview of required review functions

Figure 3 shows the relationships between the functions at the second level of the hierarchy shown in Figure 1. It also shows the relationships between these second level functions and the preconditions shown in the context diagram, Figure 2.

Each of these are detailed in this clause.

NOTE   In this clause the requirements specify that specific persons or groups of persons are responsible for carrying out the functions. The particular responsibilities were chosen with a view to preserving the independence of the review results, while at the same time encouraging teamwork between the reviewers and the project personnel.
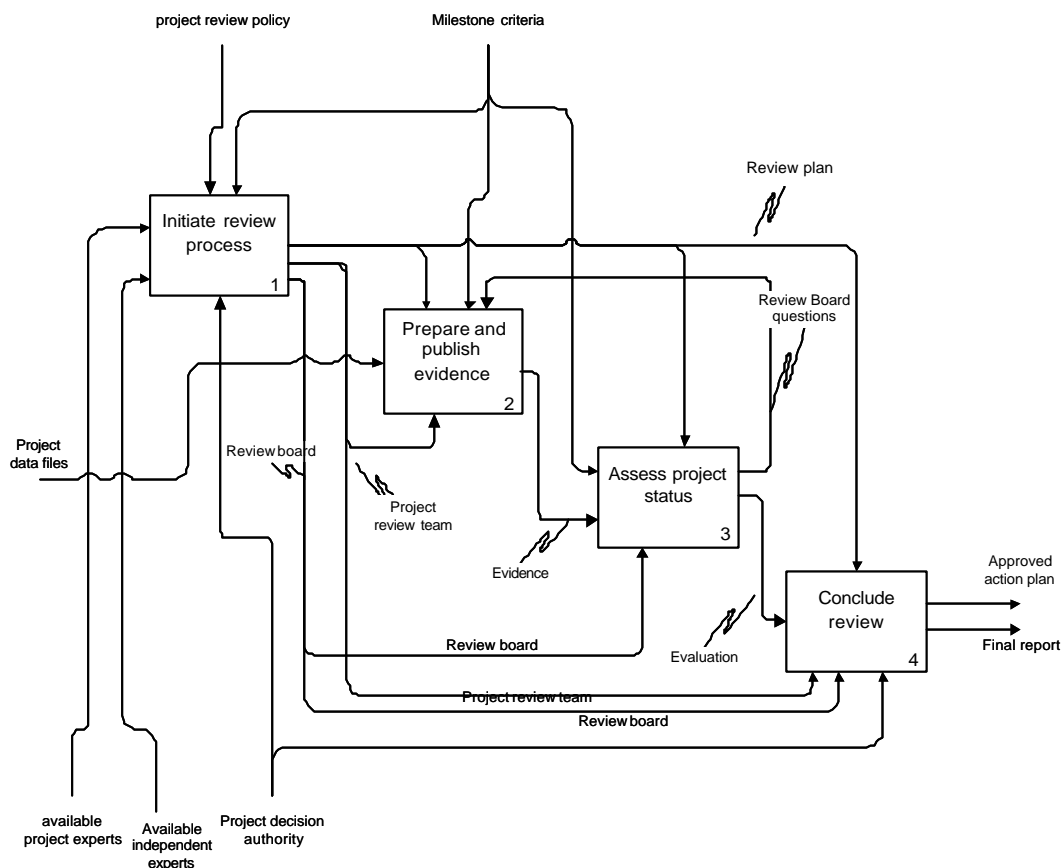
Figure 3 — Subfunctions of "Evaluate project status"

5.2 Initiate review process [1]

5.2.1 Overview

Figure 4 shows the relationships between the required review functions for initiating a project review. Elements of both the milestone criteria and the project review policy can participate in the control of each of these required review functions ([11]-[14]). Therefore these controls are shown as merged at the top of the figure.

The purpose of this group of functions is to put in place the controls and mechanisms necessary for the remainder of the review process.

project review policy   milestone criteria
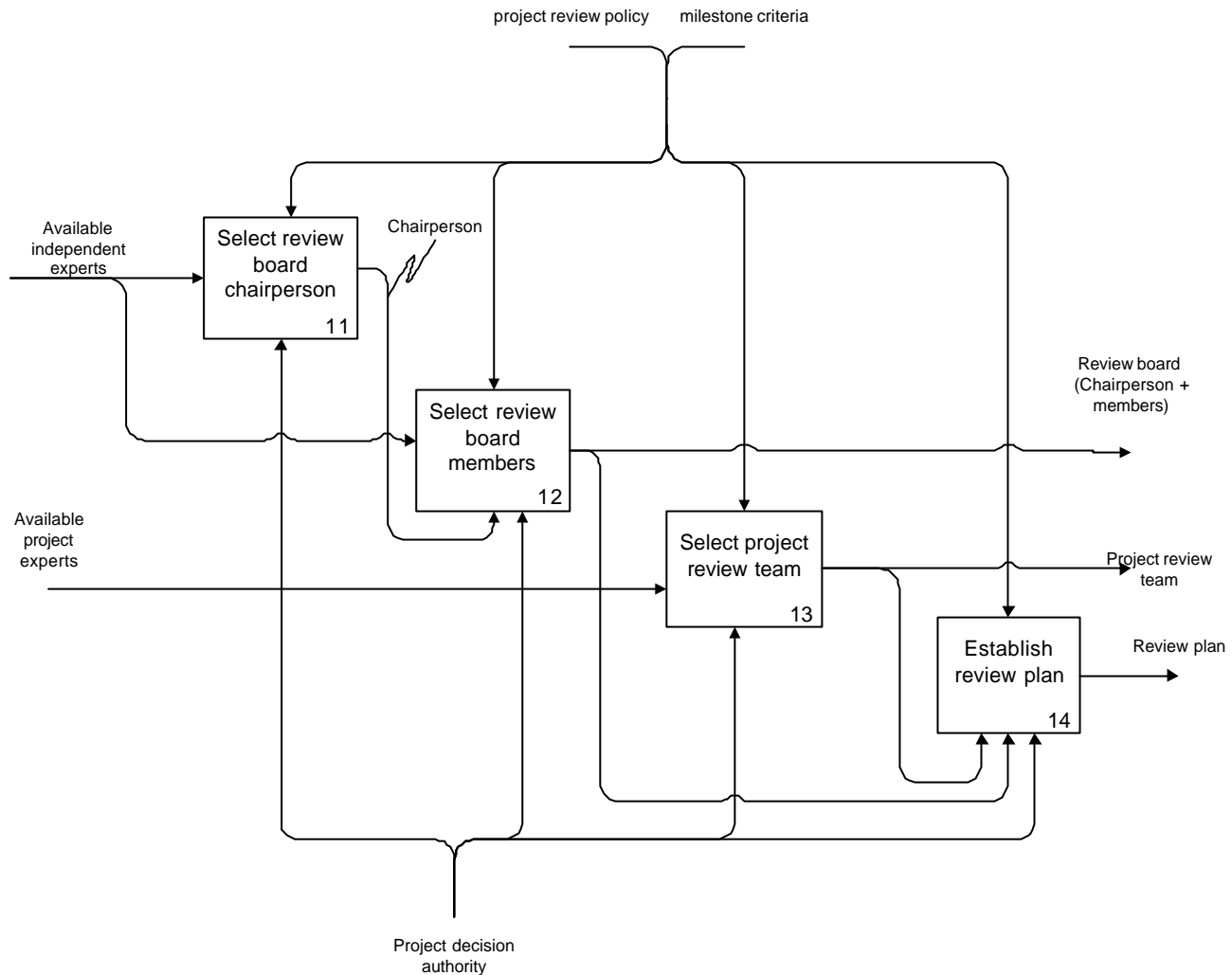
Figure 4 — Initiate review process

5.2.2   Select review board chairperson [11]

The project decision authority shall appoint a review board chairperson from the field of available independent experts, guided by the technical demands of the specific milestone criteria, and by the project review policy.

5.2.3   Select review board members [12]

The review board chairperson shall select review board members with the concurrence of the project decision authority, guided by the technical needs of the milestone criteria and by the project review policy.

5.2.4   Select project review team [13]

The project decision authority shall select a project review team, guided by technical demands of the milestone criteria and by the project review policy.

5.2.5   Establish review plan [14]

The review board chairperson shall establish a review plan with the participation and consent of the review board members, the project decision authority, and the project review team.

The participants should consider the following factors in preparing the plan:

a)   scheduling of publication and availability of evidence;

b)   meeting format and schedule;

c)   particular goals of each meeting;

d)   means of recording the proceedings of the review and communications; and

e)   The medium, format, and style of publication should be determined by the review plan.

5.3 Prepare and publish evidence [2]

5.3.1 Overview

Figure 5 shows the functions required for preparation and publication of evidence. The purpose of these functions is to provide detailed technical evidence that the project milestone has been reached.   The term "publication" is used here with a broad interpretation.

The type of evidence depends on the technologies involved and the phase of the project. The evidence should contain information about the methods used to reach conclusions as well as the conclusions themselves. Depending on the specific milestone criteria, the project review team should consider including the following types of evidence:

⎯   test methods and results,

⎯   functional analyses,

⎯   design drawings,

⎯   mission scenarios and operations concepts,

⎯   inspection reports,

⎯   simulation methods and results,

⎯   trade-off study reports, and

⎯   risk analyses.

Evidence can be ambiguous or incomplete when viewed by the review board. Therefore this function has two subfunctions: "publish initial review material," and "answer questions." The evidence for achievement of the milestone consists of the combined results of both of these.
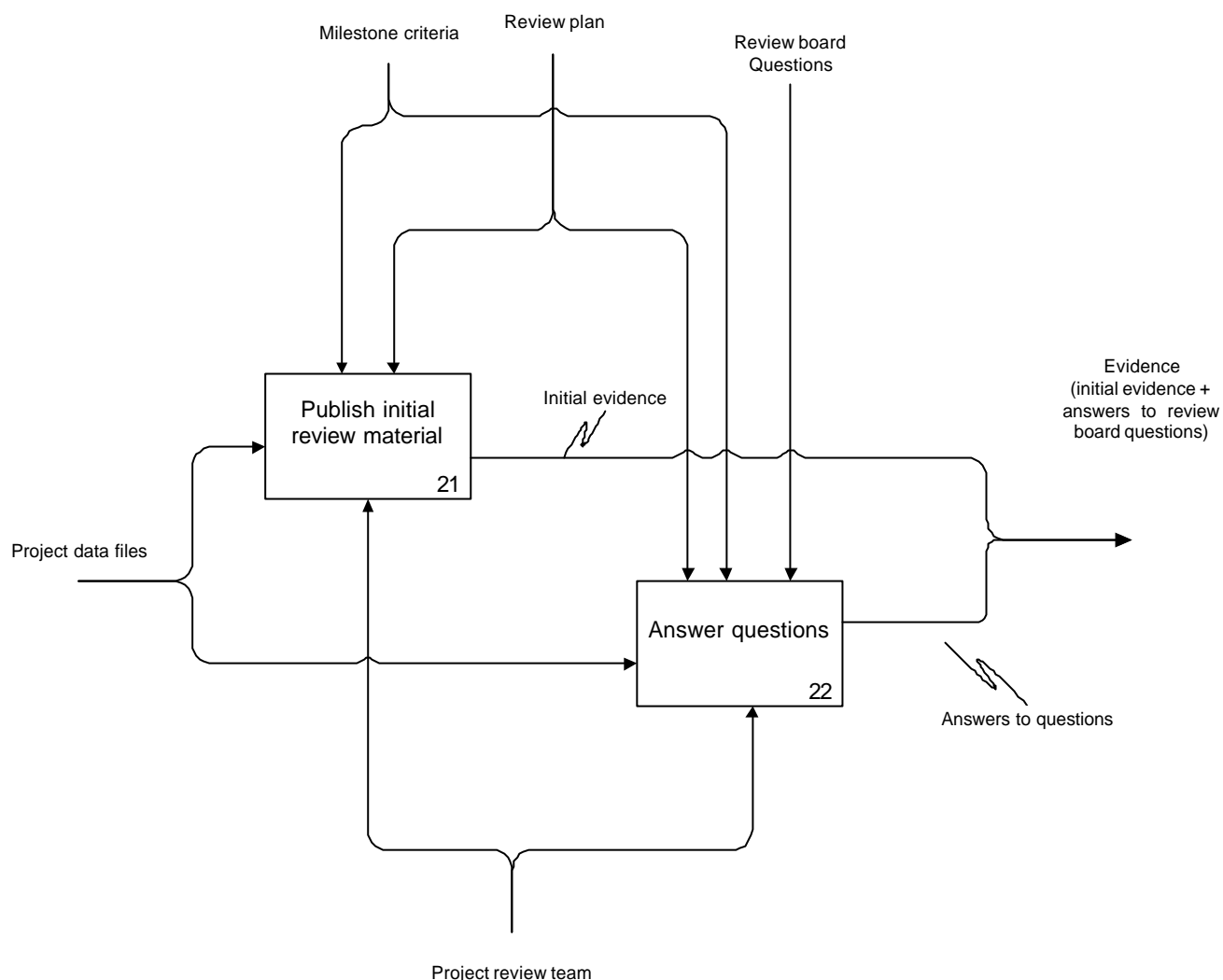
Figure 5 — Prepare and publish evidence

5.3.2 Publish initial review material [21]

The project review team shall prepare and publish initial evidence of the achievement of the milestone criteria. The format, schedule, and content of these publications shall be in accordance with the review plan.

5.3.3 Answer questions [22]

The project review team shall prepare answers to questions from the review board concerning ambiguities or incompleteness of the initial evidence.

5.4 Assess project status [3]

5.4.1 Overview

Figure 6 shows the functions used to assess project status. It is important that the inputs consist of both the evidence prepared by the review board and the milestone criteria. The output is the initial evaluation of the project status relative to the milestone criteria.

NOTE   Functions 31 and 32 are logically separate functions, but this does not imply that they are performed sequentially, or at different times. Logically, the evaluation of the achievements can only be based on evidence that is accepted by the review board as complete and unambiguous.

Review plan

Evidence

Evaluate quality of evidence

31

Accepted evidence

Review board questions

Milestone criteria

Evaluate achievements

32

Evaluation
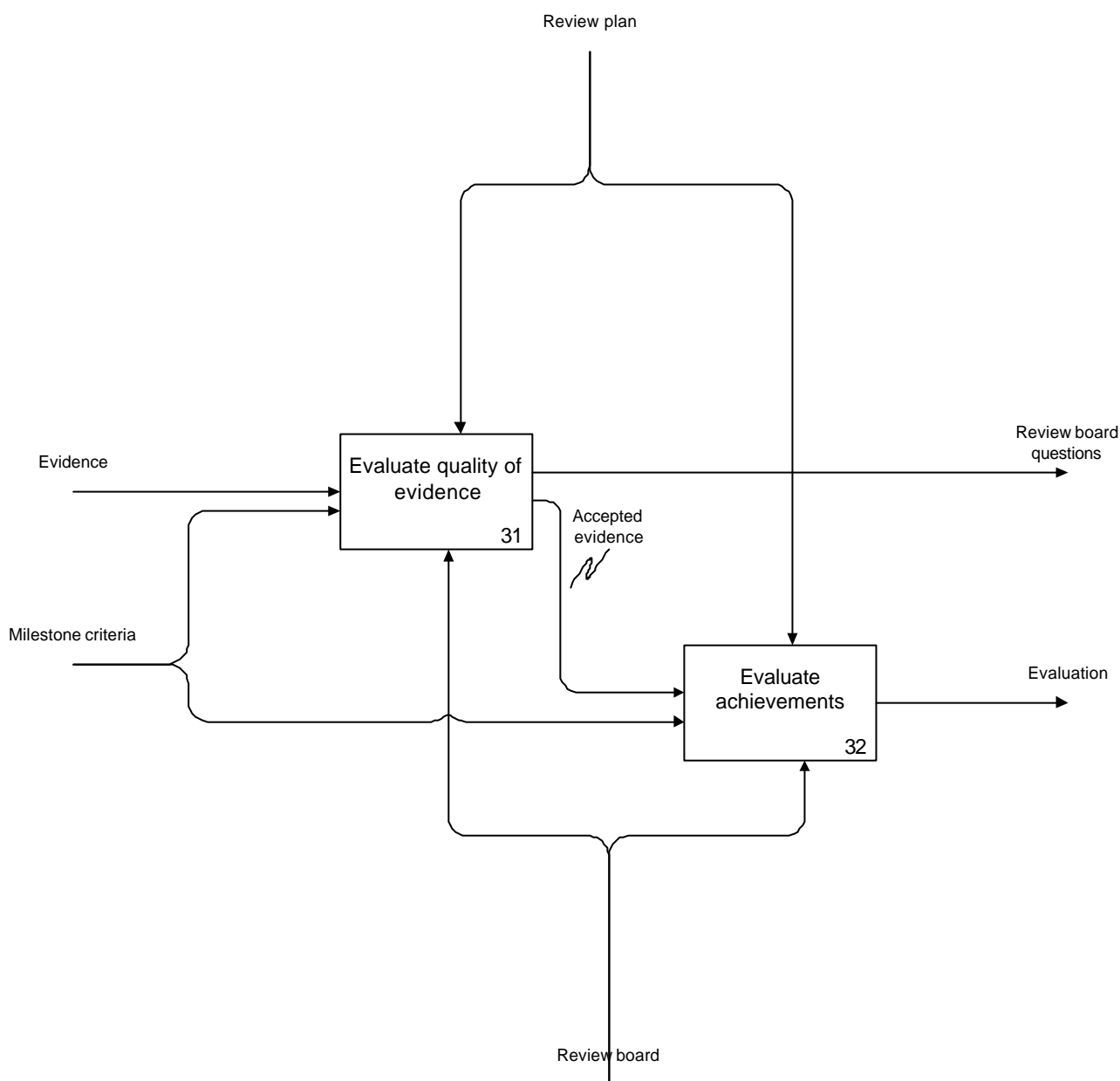
Review board

Figure 6 — Assess project status

5.4.2   Evaluate quality of evidence [31]

The review board shall evaluate all evidence submitted for completeness, consistency, and unambiguity, and shall submit questions and requests for clarification or completion to the project review team, and shall provide the accepted evidence.

5.4.3   Evaluate achievements [32]

Based on the accepted evidence and in conjunction with the milestone criteria, the revi ew board shall produce an evaluation of the project status relative to the milestone criteria. The evaluation should include:

⎯ identification of milestone criteria that have been met;

⎯ identification of milestone criteria that have been achieved; and

⎯ identification of milestone criteria that have not been achieved.

For those criteria that have not been achieved, the evaluation should include an estimate of the risk to the project as defined in ISO 17666 if the next phase is entered without achievement of these.

NOTE   Risk is defined in ISO 17666 as a "circumstance that has both a likelihood of occurrence and a potential negative consequence to the project. An estimate of risk includes both of these parameters. The management of risk, i.e., the establishment of a number of possible courses of action and choosing between them is a responsibility of project management and is not covered by this international standard.

5.5 Conclude review [4]

5.5.1 Overview

Figure 7 shows the functions used to conclude the review. The purpose of this set of functions is to identify and carry out any actions that are necessary for the project to proceed to the next phase.

NOTE   In the best case, there will be no additional actions needed. In the worst case, there will be no actions the review board considers adequate to justify proceeding to the next phase. In either case, this is an enterprise management or a contractual issue. The function of the review is to present as objectively as possible the true project status and a recommended path for correction if necessary. It is the sole job of appropriate management to decide what course to take.

Plan for review
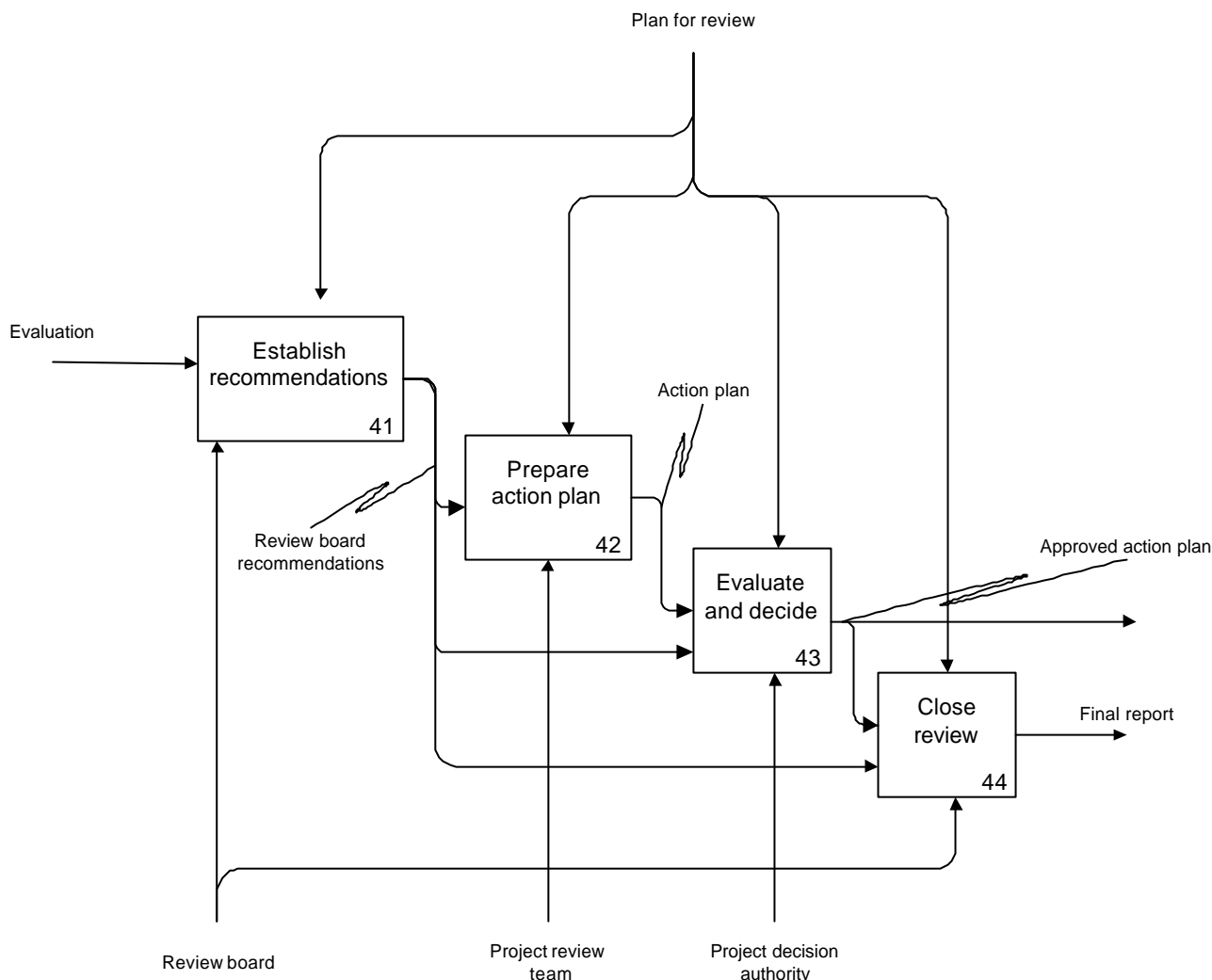
Figure 7 — Conclude review

5.5.2 Establish recommendations [41]

The review board shall examine the achievements and issue recommendations for correction of any deficiencies that were identified in the evaluation.

Recommendations may include development of plans to do further technical work, or otherwise re-plan the next phase, as well as recommendations for completion of technical tasks not yet completed satisfactorily.

NOTE   Since it is generally in the best interests of the project to close out the review, and since some technical corrections may take significant time to achieve, it is sometimes the best policy to make new plans for the next phase that take into account a different technical starting point.   Whether this is to be done is a management and contractual issue.

5.5.3 Prepare action plans [42]

The project review team shall prepare an action plan according to the recommendations.

NOTE   The project review team may be augmented at any point where it is necessary to perform its role, including this point. "Select project review team" is a function, not a discrete event, and can be carried out in parallel with any other function.

5.5.4 Evaluate and decide [43]

The project decision authority shall approve the action plan prepared by the project review team based on the recommendations, conclusions and action items of the review board.

5.5.5 Close review [44]

The review board shall close the review and issue a final report that records the results of the review.

6 Reviews designated in ISO 14300-1

The specific reviews listed in Table 1 are required or recommended in ISO 14300-1. Additional other types of reviews are contained in the informative Annex B.

Table 1 — Reviews required or recommended by ISO 14300-1

Name of review	Program milestone (Phase ending)	Typical milestone criteria
Preliminary Requirements Review (PRR)	End of phase A	Function tree issued, Reference Functional Specifications issued, Preliminary Technical Specifications Assessment of each potential concept (technical, cost and schedule), and the associated risks.
System Requirements Review (SRR)	During phase B	System Technical Specification issued, Main interfaces defined, Allocation of performances to lower levels issued,
Preliminary Design Review (PDR)	End of phase B	System Technical Specification approved, Main critical Technical Specifications issued, Choice of the solution to be developed, Development Plan issued,
Critical Design Review (CDR)	End of detailed design activities,	Design Data file issued, Qualification Test plan issued,
Qualification Review (QR)	End of phase C in case of separated C and D phases, End of C/D phase in case of integrated C and D phases	End of Qualification tests, Design Justification Data file issued,
Pre-Shipment Review (PSR)	During, or end of, phase D, after end of manufacturing and verification of each product to be delivered,	End Item Data Package issued. Verification of delivered product completed.

Annex A
(informative)

Main Elements of the Process Diagrams

A.1 Introduction

The diagrams used in Clauses 5 and 6 of this International Standard conform to the syntax and semantics of the IDEF0 standard for process modelling as published in IEEE 1320.1-1998. This is, for purposes of the current document, the same as the IDEF0 standard presented by the US National Institute for Standards and Technology, Federal Information Processing Standard: FIPSPUB183. This annex presents an overview of the elements of the IDEF0 modelling standard that are used in Clauses 4 and 5.

IDEF0 diagrams are used widely for description and specification of "what to do" models in business and industry. They were developed as part of a US Air Force project to develop ways of improving manufacturing operations. They are currently in use within the development effort for the various parts of ISO 10303, *Industrial automation systems and integration—Product data representation and exchange* for the development of application reference models (ARM).

A.2 Basic concepts

The IDEF0 diagrams provide a formal graphical syntax and semantics for describing or specifying processes. Figure A.1 shows the main elements of the IDEF0 standard that are needed for specification of the project review process.
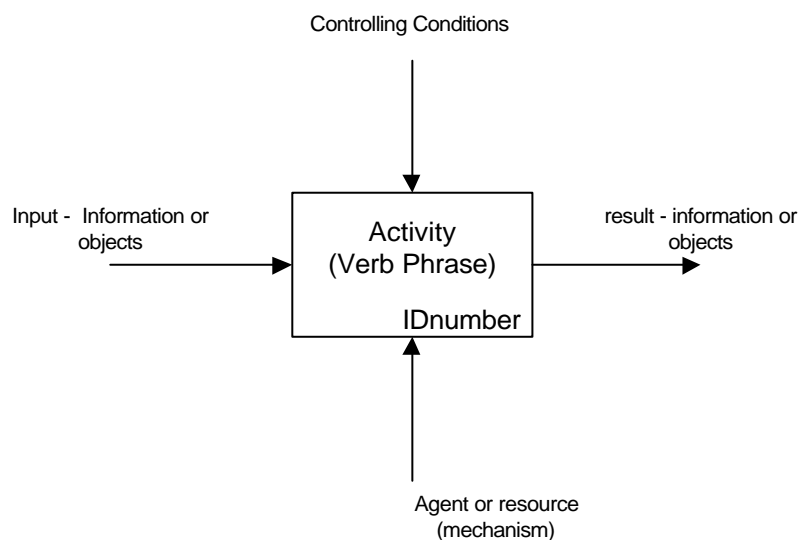

Figure A.1 — IDEF0 Diagram Basics

The main points are as follows:

— Functions.

  — A function is an activity, process, or transformation, identified by a verb or verb phrase that describes what must be accomplished.

  — A box represents a function.

— The content of the box is the verb phrase characterising the function.

— A function can be decomposed into sub functions.

— Input arrows

   — An arrow that represents the input data or objects passed to a function for transformation.

   — Input arrows enter the function box on the left.

— Output (or result) arrows

   — An arrow that represents a result, or output of a function.

   — Output arrows are shown leaving the function box on the right.

— Mechanism arrow

   — An arrow that represents an agent or resource or other means used to perform a function.

   — Mechanism arrows enter the function box at the bottom.

— Control arrow

   — An arrow that represents the controlling conditions required to produce correct output.

   — Control arrows enter the function box at the top.

A.3 Context diagram

The process is bounded (i.e., the scope defined) by means of a top level context diagram (Figure 2), consisting of a single function box representing the total process, with bounding arrows representing the total interface of this process with the world outside the process (to the level of abstraction of the intended specification or description).

Annex B
(informative)

Other Reviews

B.1 Other milestone reviews

Table B.1 lists other reviews commonly used. In some cases, there are alternate names that are used for similar milestones. Reviews are listed in alphabetical order for ease of reference.

Table B.1 — Commonly used reviews not specified in ISO 14300-1

Review name	Program milestone (Phase ending)	Typical milestone criteria
Acceptance review	During, or end of, Phase D, after end of manufacturing and verification of each product to be delivered	Completion of Flight model production, and verification (including acceptance) or proto-flight tests, EIDP, and LB
End of Life Review	Utilization phase	Completion of Mission objectives.
Flight Readiness Review Launch Readiness Review	Launch campaign phase at a launch site (Launch site acceptance test phase)	Completion of Launch site acceptance tests, Launch safety confirmation, Risk assessment, Launch permission by relevant authorities.
Mission Definition Review	Mission analysis phase	Completion of Mission definition, evaluation of its costs, schedule, and risks.
Operational Readiness Review	The last phase prior to committing the product to operations (For example, for an earth satellite mission, the transfer to orbit phase)	Completion of the designated final pre-operational phase (for example, for an earth satellite mission, completion of the transfer orbit phase)
Commissioning Review	The last phase prior to committing the product to operations	Completion of the designated final pre-operational phase
Production Readiness Review, sometimes termed a Manufacturing Readiness Review	Detailed design stage during or at the end of Development phase	Completion of Production plan
Software Specification Review	Software specification stage during or at the end of definition phase	Completion of Hardware TS and Software TS.
System Functional Review	FS specification stage, during Mission analysis and Feasibility phase.	Completion of Mission definition and its FS.
Test Readiness Review	During Production phase	Completion of Flight model manufacture, Detailed test procedure documents.

B.2 Interim reviews

In addition to the milestone reviews a well regulated project should have interim progress reviews. These may be periodic (quarterly, for example), or ad-hoc, or on some other planned basis. They may be called, for example, Peer Reviews, Interim Technical Reviews, or other similar names.

In implementing Interim Reviews, a project should utilise the process specified in Clause 5 and Clause 6. The requirements and recommendations should be tailored as appropriate, particularly with respect to

— the success criteria used in place of milestone criteria, and

— the composition of the review board.

B.3 Ground Segment Reviews

Table B.2 lists other reviews commonly used. In some cases, there are alternate names that are used for similar milestones. Reviews are listed in alphabetical order for ease of reference.

Table B.2 — Ground segment reviews not specified in ISO 14300-1

Name of review	Program milestone (Phase ending)	Typical milestone criteria
Ground Segment Requirements Review (GSRQR)	Mission Operations concept established, and Mission implementation requirements agreed .	Mission Implementation Plan, Space-Ground interface, and requirements for GS elements established.
Ground Segment Design Review (GSDR)	Completion of GS design definition	Design definition documents for all GS elements
Ground Segment Implementation Review (GSIR)	Development of all GS elements complete.	Verification of GS elements. GS Integration Plan
Ground Segment Readiness Review (GSRR)	GS elements, procedures and personnel are ready for validation	GS elements integrated. Operations procedures, Validation plans and mission data established.
Operations Readiness Review (ORR)	GS elements, procedures and personnel are validated and ready for operations.	Approved and validated operations plans and procedures. Trained and certified personnel
Commissioning Review	See Table B.1	Commissioning test results.

Bibliography

ISO 15865, *Space systems – Qualification assessment*

ISO 17666, *Space systems — Risk management*

IEEE Std 1320.1-1998, *IEEE Standard for Functional Modelling Language—Syntax and Semantics for IDEF0*